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GAS APPLIANCE DESIGN

IT will take a long time for the reports and papers presented at the fullsome conference of the International Gas Union to ' sink in.' Today there is a preponderance of theoretical 'ideas,' many of them semi-baked though garnished with a veneer for which the modern universities and technical colleges are in part responsible. The gas industry has been nationalised for three months, and is singularly quiescent under the new régime. So far there has been much back scratching and little back kicking. There has been a great deal of talk about the team spirit and far too little encouragement of the technical man who might feel that he has something useful to say in the present era of regimentation. Flattery as a means to a job which is secure seems to appeal to many in this country at the present time, including gas engineers. And now that the transient Minister of Fuel and Power, Mr. Hugh Gaitskell, has effected his political *coup*, there seems to be a tendency towards complacency.

The conference of the International Gas Union is something of the immediate past, and three years will elapse before another congress of the kind will be staged. This will provide breathing-space for both organisers and authors. How, we wonder, is this breathing-space going to be occupied? Or is the interim to prove a vacuum for the preparation of more and more erudite contributions? In brief, do we intend to profit by the work put into the 1949 conference of the I.G.U.? Or are we going to suffer from what we think is symptomatic of the present age, an inverted pyramid of research, many after-dinner speakers on its behalf knowing little about its organisation and purpose?

To our mind the 'team spirit' could benefit by a wash and brush-up within the gas industry—and there is no need for the exhortations of trade unionists or co-operative enthusiasts in this salutary exertion. Obviously the team as such should pull in one direction ; but horses, oxen, or even mules are known to vary individually in drawing power. Again, the direction must vary ; and this brings us to the question of appliance design. Many years ago the Gas Light and Coke Company (as it was for more than a century and a quarter) rightly decided to establish a special section to cover appliance design. The step was taken in its own interests and through the years it has proved of immense benefit to the gas industry of Great Britain and overseas. A dominant factor which led to the establishment of Watson House was the 'safety factor.' The Company had heavy responsibilities and it shouldered them with courage ; the gas consumer was the gainer. Watson House was not in its early days looked upon with 100% affection by the manufacturers of gas appliances, who felt (maybe not without good reason) that there was a 'theoretical' element at Nine Elms Lane (later at Fulham) and that many of the young and earnest scientists engaged adopted a high and mighty attitude while knowing little about business problems and nothing about foundry practice. Watson House broke new ground, but it broke that ground with a certain clumsiness. There was team spirit at Watson House (and fortunately the team spirit prevails there), but the early members of the team created outside that privileged organisation, outside those sheltered precincts, a good deal of antagonism. In those days Watson House was always right. This attitude might have amused Euclid, who doubtless had his ' off ' moments. However, the conception of Watson House was imaginative, and its development is a credit not just to the Gas Light and Coke Company but to the British gas industry, for the element of flexibility was brought into play. Watson House has done good work in sterilising bad and unsafe design, and also in encouraging the new idea. It has broadened its outlook, though, of course, it has never been faced with a business risk.

We feel that business risk is not just a spice to whet the appetite of financiers but a deep and determining element in changing human circumstances ; and there is nothing so permanent as change. We know that today there is team spirit among the workers at Watson House and that the spirit extends to encompass their confrères employed by the firms of gas appliance manufacturers who are daily faced with risk and are unafraid to grasp nettles. Some of the problems with which private enterprise manufacturers have to deal were touched on in a broad way at the I.G.U. congress by Mr. A. R. Bennett, who is Research Manager to Radiation Ltd., in a paper having the title 'A Study of Progress in the Domestic Utilisation of Gas.' In our special Congress Number of July 6 we summarised the paper and published a full report of the discussion on it—a discussion limited only by the time available at the meeting.

MEETING DEMAND

ONE of the fundamental difficulties facing the appliance designer at the present time, apart from the effect of the time lag, is that it is often difficult to define the essential requirements of a situation. Mr. Bennett, calling attention to this problem, remarked that in the rational design of any equipment to meet human needs, especially in matters affecting domestic routine, which is often strongly conditioned by convention, it is necessary to go beyond the current conception of those needs to the underlying phenomena interpreted in a scientific sense. Expanding this point the author went on to say that the increasing complexity of the apparatus of civilisation renders it less and less practicable to base plans for future developments on the popular assessment of current

needs. 'In a period of rapid technical development, giving the public only what it wants can in a relative sense cause stagnation, since the horizon of the appliance user is limited by the apparatus and technique with which he is familiar and which, although probably far from ideal, he has learnt to tolerate. It is most certainly restrictive and may even be completely misleading to take current requirements, as seen, for example, by the salesman, as the ultimate objective in the design of domestic, or indeed any other, appliances. Not only are real needs often inarticulate, but only a few specialists can be aware of the wider possibilities opened up by developments in pure science or in technology. What is needed, therefore, is a detailed analysis of the underlying physical and biological processes and requirements so that design can lead rather than follow public demand.'

Mr. Bennett had some interesting comments in making a comparison between British and American practice in appliance design. Fashion and national temperament exert influences which sometimes manifest themselves in surprising forms. In the United States of America the urge to adopt the latest novelty is greater than in some other countries. This leads to a much greater domestic appliance replacement rate than, for example, in Great Britain. Such differences can react on design (in as much as durability is less important in the former country), both materials and methods of manufacture being affected in consequence. The American outlook also encourages manufacturers to introduce novelty for its own sake, quite apart from whether the change is a genuine improvement or not. Accidental factors, such as the relatively high sulphur content of British coals relative to those of Germany and the United States of America, affect the severity of corrosion problems and determine the quality of materials which must be used in construction. While mild-steel combustion chambers are usable in regions supplied with fuel of low sulphur concentration, corrosion-resisting steel is necessary when the sulphur content is high. This obviously reacts on cost and on manufacturing technique. Again, the size of the market for any type of appliance is in itself a major factor in design, determining the extent to which, for example, the incorporation of pressed sheet-metal work is economic, as well as affecting many other details of manufacturing technique, all of which are reflected in style and cost.

We have quoted at some length from Mr. Bennett's paper to underline some of the problems which face the manufacturer of domestic gas appliances. In the discussion Dr. H. Hollings spoke of the requirements of gas undertakings themselves, among other suggestions putting forward the view that in the field of water heating the work of the appliance designer would have to follow further studies of the overall cost of supplying hot water service, including the cost of maintenance. Design work, he said, must also follow further propaganda and education of the consumer to a proper appreciation of the standards of hot water service which could be supplied by gas. And he added that 'with more integration in the gas industry it is getting no easier for the supply undertakings to maintain personal contact with the consumers, and for this and for other reasons maintenance costs tend to rise.' This matter of personal contact is of the utmost importance, and we have consistently stressed the need for maintaining it. Surely if there is a declining standard in this respect there is something wrong with the organisation of the gas industry, and the responsibility must now be placed on the area Boards, whose policy should be to foster those personal contacts which in the past did so much to build the strength of the industry and to assure the consumer that he or she could rely on individual service. Decline in such service would point to a weakness—a grave and far-reaching weakness—in the area Board organisation.

DRY COOLING OF COKE

A Working Group set up by the Ministry of Fuel and Power has completed a survey of information on dry coke cooling processes and assessed the possible advantages and disadvantages of employing them, and their potential contribution to the national economy as a means of saving fuel. In dry cooling plants the hot coke from coke ovens or gas retorts is cooled in a chamber by circulating inert gases through the coke. The heated gases leaving the chamber are used to raise steam in a waste heat boiler. Consideration of the evidence obtained has shown the need for standby steam plant, emergency wet quenching arrangements, or adequate standby cooling capacity, and certain safety precautions in operating the plant. The size, ignitibility, and wettability of dry cooled and wet quenched coke have been compared. From all the information obtained, estimates have been made of the net costs of installing and running dry cooling plants in connection with new and with existing carbonising plants. The conclusions reached necessarily depend upon maintenance of the present relationship between costs of capital equipment, labour, &c., and upon the future availability of low-grade fuel for steam raising. It is concluded that there is little scope for further application of dry cooling in the gas industry, except for large gasworks where coke ovens may be increasingly used. On the other hand, the economic advantages and fuel savings arising from adoption of dry cooling at new or existing coke ovens, for which a steam yield of approximately 1,000 lb. per ton of coke cooled may be expected, are sufficient to warrant close consideration being given to the installation of dry cooling plant. Each case clearly needs to be treated on its merits. It seems clear that dry cooling equipment can give reliable service when maintenance is adequate, but its reliability as a steam producer obviously depends upon steady supplies of hot coke. On later pages we give an abstract of the report.

CONSERVATIVE POLICY

The Conservative Party's statement of policy, which will form the basis of the party's programme at the general election, was published last Saturday under the title 'The Right Road for Britain,' and Mr. Churchill spoke on the policy at Wolverhampton the same day. It is made clear that the Conservative Party will undertake no further nationalisation. It will not proceed with the Act to nationalise iron and steel, though there is no course other than to leave some industries nationalised. It is maintained that most of the nationalised industries are wrongly organised, that they are over-centralised, that even minor decisions are taken at a distance from the scene of action, and only after great delays, and that the consumer has little redress for grievances; 'consumers' councils are remote and ineffective.' A Conservative Government will, therefore, reform the undertakings which remain nationalised on the following lines: The greatest degree of decentralisation will be carried out in order to establish as much local control and responsibility as possible. Restoration to private management ancillary activities, such as farms under the Coal Board and hotels formerly owned by the railways. More use will be made of independent price tribunals. The Parliamentary control of the accounts of the undertakings will be strengthened. Time must be found for a periodic review of each industry by Parliament.

Every nationalised undertaking must be within the purview of the Monopolies Commission, or some similar body. The power of appointment by Ministers will apply only to the main boards. If the Minister's powers to give directions have been left vague they will be clarified.

'We recognise,' states the document, 'that Scotland feels acutely the increased dependence on Whitehall which has resulted from over-centralised nationalisation. We are holding a separate inquiry into Scottish problems.' Regarding specifically the gas and electricity industries, the document says: 'It is too early yet to decide on the final form of these industries. But we can say now that the present area Boards and the area consumers' councils cover too large an area to be in touch with local opinion. We shall review the possibility of introducing in each district representation of local opinion in a suitable form.' 'I assert,' said Mr. Churchill at Wolverhampton, 'that all nationalised industries have ceased to be assets to the public and have become instead burdens upon it. The losses they make will be paid for either by the taxpayer through the Exchequer, or by the consumer, who is also a taxpayer, in higher prices. In all cases a worse service is given to the public.' Mr. Churchill added: 'We cannot uphold the principle that the rewards of

society must be equal for those who try and for those who shirk, for those who succeed and for those who fail.' Is it not time, as was argued by the *Observer* last Sunday, that Socialism encourages the average man to expect the State to make everything comfortable for him, with no great call for exertion on his part? Is it not true that in Britain to-day we are suffering from a decline in the old feeling that it is part of a man's duty and satisfaction to do any job he tackles thoroughly and well.' And does not this apply to the gas industry as to any other industry?

Personal

Mr. A. DALGLEISH, member of the South Eastern Gas Board, was awarded the C.B.E. in the recent Birthday Honours List, in recognition of his many years of public service, and particularly for his work on the Colonial Labour Commission. The Investiture, at Buckingham Palace, took place on July 26.

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Mr. J. HAMILTON, Manager of the Barrhead Gas Company for 29 years, until the undertaking was nationalised, has been honoured by the Directors, staff, and workers. At a presentation ceremony in the boardroom at the works, Mr. Hamilton received a silver tea service, which was handed over by Mr. Hendry Heys, who was a Director of the Company. Mr. Heys said that during the past 29 years the company progressed greatly in manufacture and distribution. He had looked back on his Dumfries visit as having accomplished a 'gilt-edged job.' Production had increased considerably during Mr. Hamilton's managership and Barrhead's gas compared very favourably with any works of similar size. In finance they could beat them all, he added. The results had been obtained very largely by the ability of Mr. Hamilton, who had never stinted himself in his service to the undertaking. Replying, Mr. Hamilton said that he had always contended that they were all employees performing a public service and the honours of success were the results of their united efforts, which could not have been achieved without a spirit of comradeship. Since the nationalisation of the industry, Mr. Hamilton has been Engineer and Manager of the Barrhead undertaking of the Scottish Gas Board.

Appointments

South Western Gas Board

The following appointments are announced by the South Western Gas Board :—

Deputy Secretary and Solicitor.—A. LAMBERT, LL.B.
Area Scientist.—Dr. A. MARSDEN, M.SC., F.R.I.C., M.I.CHEM.E.
Coal and Coke Officer.—J. H. THORNHILL.
Chief Industrial Gas Officer.—T. H .PARDOE, ASSOC.M.INST.GAS E. M.INST.F.
Chief Industrial Relations Officer.—K. H. STRINGER.
Deputy Coal and Coke Officer.—W. L. WRIGHT, F.I.A.C.

Eastern Gas Board

The Minister of Fuel and Power has appointed Mr. W. C. KINCAIRD, of Kenton, Middlesex, an official of the North Thames Gas Board, to be a part-time member of the Eastern Gas Board.

The following appointments have also been made to the Watford Division of the Board:
W. A. EVETTS, *Engineer;* W. G. PHILLIPS, *Commercial Manager.*

West Midlands Gas Board

The following appointments have been made by the West Midlands Gas Board:
Superannuation Officer, S. WILSON (Treasurer's Department, South Shields).
Area Home Service Adviser, Miss O. L. HUMPHRIES (Birmingham).
Deputy Divisional Manager, Walsall and District Division, A. ROBINSON, M.INST.GAS E. (South Staffordshire Mond). Mr. Robinson will also retain the position of Chief Engineer at South Staffordshire.
Divisional Engineer, Walsall & District Division, W. T. NEWTON (Woodall-Duckham).
Divisional Engineer, Warwickshire Division, A. W. ATTWOOD, A.M.I.MECH. E. (Coventry).
Divisional Engineering Assistant, Worcs. and Herefordshire Division, K. JONES, ASSOC.M.INST.GAS E. (Kidderminster).
Assistant Engineer and Manager, Dudley Division, A. GRIFFITHS, A.M.I.STRUCT. E. (Walsall).
Engineer and Manager, West Bromwich Division, W. E. PLEVIN, B.SC. (Oldbury).
Station Engineer, Oldbury Division, A. BLINKHORN, B.SC. (Oldbury). Mr. L. H. THOMAS, Smethwick, will also be responsible for the Oldbury works.

West Midlands Changes

What used to be the staff magazine of the Birmingham Corporation Gas Department has grown up into the *West Midlands Gas Board Magazine,* still under the same Editor, Mr. J. K. Barnett, and the first number of the new series carries a message of greeting from Mr. G. le B. Diamond, Chairman of the Board, who offers praise to all who have had a part in the smooth and successful changeover. Much of the contents was prepared before Birmingham's boundaries were broken down, but it is intended to make the magazine fully representative of the area as a whole, to which end divisional correspondents have been appointed to keep the Editor informed of the business and social activities of every part of the area.

Here are some personal notes from the magazine which are of more than divisional or area interest: Following the appointment of Mr. C. M. D. Belton as Shropshire Divisional Manager, Mr. A. V. Wainwright, formerly Works Manager, has been appointed Engineer and Manager at Shrewsbury, with Mr. A. S. Greenway as Works Superintendent. Mr. F. Caudwell, formerly Shrewsbury Distribution Superintendent, has become Shropshire Divisional Distributing Engineer, and Mr. T. Purslow has been appointed Distribution Superintendent at Shrewsbury. Mr. G. W. Wilcock, formerly of Gas Consolidation, Ltd., has been appointed Travelling Chemist for the Division, with Mr. R. Spencer as his assistant.

In the North Staffs Division, where Mr. J. E. Stanier has become Divisional Manager, Mr. J. S. Warrilow, Deputy Chief Engineer and General Manager, has stepped up into Mr. Stanier's place at Stoke-on-Trent. Mr. L. W. Johnson, Technical Assistant in the Stoke-on-Trent City Treasurer's Department, has been appointed North Staffs Divisional Accountant. Mr. J. Pickerill, Accountant for the former Newcastle-under-Lyme Corporation Gas Department, has become Chief Commercial Assistant to the Stoke-on-Trent undertaking. Mr. W. E. Clarke, Administrative Assistant at Stoke, has been elevated to the corresponding office in the North Staffs Division.

In the Warwickshire Division, Mr. A. E. West, formerly Deputy Engineer and Manager at Coventry, has succeeded his former chief, who is now Divisional Manager at Birmingham. Mr. L. Drew has been appointed Commercial Manager at Coventry in succession to Mr. J. Swan, now Deputy Secretary to the area Board, and Mr. A. L. White is the new Deputy Commercial Manager at Coventry.

Mr. E. A. Goodland, Assistant Manager at Birmingham prior to vesting day, is now Manager at Walsall in place of Mr. A. Allen, who has gone to Warwickshire as Divisional Manager. Following the departure of Mr. C. F. W. Rendle to take up his post as Divisional Manager for Worcestershire and Herefordshire, Mr. P. E. Gallaher has become Engineer and Manager at Redditch. Mr. T. S. Hackett is Secretary of the Redditch District and Mr. H. E. Chapman is Assistant Engineer and Manager at Redditch. Nationalisation has brought to a close a long record of service to the gas industry by Mr. L. E. Clift, for 59 years a member of the Board of the Redditch Gas Company, and for 51 years Chairman. Mr. C. R. Hackett, Secretary and in later years a Director, has also retired.

In the Birmingham District, Mr. F. D. Malley, formerly Acting Secretary of the Birmingham undertaking, has become District Secretary, and Mr. R. G. Bayliss has succeeded him as Assistant Secretary.

Obituary

The death occurred on July 19 of Mr. CHARLES W. GRANT, Distribution and Sales Manager of the Newport (I.W.) gas undertaking. Mr. Grant, who underwent a serious operation in 1947, was taken ill about a month ago and died in the Royal I.W. County Hospital, Ryde.

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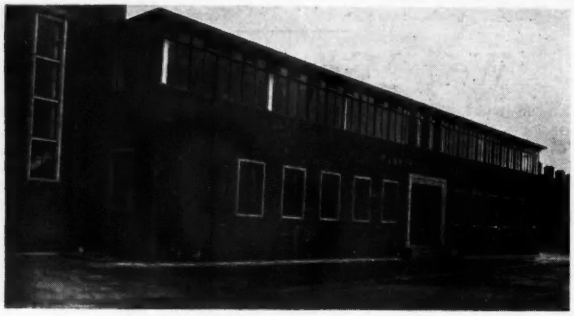
Mr. JAMES WYNNE, formerly Engineer and Manager of the Carnoustie gasworks, and one of the town's best known residents, has died at his home, Norwood, Mackenzie Street. He was 78. Mr. Wynne, a native of England, joined the staff of the Dundee gasworks in 1902, and was appointed Engineer and manager at Carnoustie at a time when the undertaking was run by a private company. The Town Council took over the undertaking in 1910.

PARKINSON AND COWAN'S NEW FACTORY



On July 19, Sir George Jessel, M.C., Chairman of the Parkinson and Cowan Group of Companies, accompanied by Lady Jessel, opened their new factory in Donegall Road, Belfast. The chief guest was the Rt. Hon. W. B. Maginnis, M.P., K.C., LL.D., Minister of Commerce, Government of Northern Ireland, who was accompanied by a representative gathering of prominent men drawn from the public, professional, and industrial life of Northern Ireland. In addition, the Companies were represented by Mr. H. P. Barker, M.I.E.E., M.INST.GAS E., Group Managing Director, and Mr. C. H. Pearson, Director and General Manager of the Gas Meter Division.

The factory, which has been designed on the most modern lines, has an area of 29,000 sq. ft. Natural lighting is provided by continuous windows in the east wall and by north lights in the roof. The roof trusses are carried on a 12 ft. deep lattice girder with clear span of 90 ft. The building comprises first floor office block and is equipped with ambulance and rest rooms, cloak rooms, canteen, garage, &c.

There has been a gas meter assembly branch of Parkinson & Cowan in Belfast since 1903. Now, with the co-operation of the New Industries Branch of the Government of Northern Ireland in the building of this new factory, the Company will also produce gas cookers including the 'Renown' and 'Crest' models; and further products of the Parkinson & Cowan Group in service of public utilities will be added later.

Mr. F. S. Clegg, who has been responsible for the Company's interests in Northern Ireland since 1937, will be in charge of the new venture.

Sir **George Jessel,** declaring the factory open, said he did not imagine for one moment that public men burdened with responsibility could have been persuaded to honour them that day had it not been for the fact that in varying degrees and from differing standpoints they had an interest in the eventual success of the venture being launched by the Company in Belfast; and he would like to tell them briefly something about the venture, the reasons which had compelled them to undertake it, and the hopes they entertained for its future success.

Continuing, Sir George remarked that their Company had long been established in Northern Ireland. They opened a branch there in the year 1903 for the purpose of supplying meters to the gas industry of Northern Ireland, and for many years past they had occupied a small factory in Raphael Street. In this factory they enjoyed the close proximity of the Gas Department, but this neighbourly advantage became offset through the years by the growing disadvantages of inadequate floor space and poor working conditions. During the war they were asked by the Air Ministry at very short notice to establish a factory in Belfast for the manufacture of aircraft wiring components. For this purpose they converted some old premises in Talbot Street, and during the peak of production employed up to 400 people there. This experience taught them two things—firstly, that Belfast labour was extremely adaptable, and, secondly, that the Government of Northern Ireland was the fortunate possessor of a public service which was not only very sympathetic towards the problems of manufacturers, but also exceptionally disposed to aid and encourage the development of manufacturing business in the City.

After the war they decided to invoke the aid of the Northern Ireland Government in improving their facilities to enable them to extend the range and scope of their manufacture in the country. The Donegall Road factory was the result, and despite the delays which had occurred in completing the work due to the national shortage of materials and building labour, they owed a very deep debt of gratitude to the Ministry of Commerce not only for their original agreement to build a factory to suit their requirements, but also for the innumerable courtesies which they had extended to the Company during its construction.

Their plans for the future involved principles beyond that of a manufacturer exercising his normal instincts to develop his business. The Parkinson & Cowan Group of Companies was concerned, through its various subsidiaries, with many lines of activity, the principal ones being the production of gas, electricity, and water meters, gas cookers and water heaters, and liquid fuel appliances and street lamps. It was also interested in specialised manufactures such as high grade leathers, precision components, and industrial plant. There was an irresistible and proper tendency for the assembly of light engineering products to be carried out as close to the market as possible, and in a community such as Northern Ireland, with a self-contained social and economic life, it seemed certain that local manufacture of light engineering goods must grow. There were three separate reasons for this. First, that by so doing a greatly improved service could be provided to their customers; secondly, it should eventually become more economical, and thirdly they would create increased local employment. Finally, it would provide opportunities for the youth of Northern Ireland to become proficient in precision engineering manufacture by the latest methods. It was their ambition to establish at Donegall Road a unit in which they would enlarge their long established gas meter making activities. In addition they intended to assemble gas cookers and perhaps other gas appliances. They also intended to assemble the measurement type Ze and Zf single and polyphase electricity meters. They would install at Donegall Road complete equipment for the assembly, test, and repair of fluid meters, and when the projected expansion of water supply in Northern Ireland came to fruition they believed that they would be able to give excellent technical and commercial service to the undertakings.

Concluding, Sir George Jessel said it was their hope and ambition that when manufacture of these products was established at Donegall Road they would be able to reduce costs to a point which would enable them to use the factory to produce goods for export, not only to overseas markets.

Forthcoming Meetings

The Annual Meeting of the Irish Gas Association will be held at the D'Olier Street lecture theatre of the Alliance and Dublin Gas Consumers' Company on Sept. 6, under the Presidency of Mr. T. D. Hamilton, J.P., Belfast. Proceedings will begin at 10.30 with a reception by the Lord Mayor of Dublin and by the Rt. Hon. James MacMahon, Chairman of the Alliance and Dublin Gas Consumers' Company, followed by the President's address. Two papers are to be given, one by Mr. J. W. Young, of Lurgan, on 'One Thing Leads to Another,' and the other by Mr. T. F. Hastings on 'Matters of Interest to the Smaller Gasworks.' The annual dinner will be held at the Royal Hibernian Hotel on the same day. On Sept. 7 there will be an outing to Glendalough, and a golf competition will be held at the Castle Golf Club, Dublin, on Sept. 8.

The 88th Annual General Meeting of the North British Association of Gas Managers will open at the Music Hall, George Street, Edinburgh, on Sept. 15. A tour for the ladies has been arranged for the afternoon, visiting places of interest in the city. There will be a civic reception in the Assembly Rooms at 8 p.m., followed by dancing. The golf competition will be played on Sept. 14 over the course of the Kilspindie Golf Club, Aberlady, and on the same day the ladies' golf competition will be held at the Baberton links, Juniper Green, Edinburgh. There will also be a ladies' putting competition on the Bruntsfield links at 10.45 a.m., on Sept. 15. The bowling competition will take place on the Granton Bowling Club Green in the afternoon of Sept. 14, and during the competition Mrs. D. D. Melvin will be 'At Home' to the ladies attending the meeting. An all-day motor coach tour has been arranged for Sept. 16, passing through the 'Scott Country' and returning to Edinburgh at 6 p.m.

Diary

Sept. 6 and 7.—**Irish Gas Association:** Annual Meeting. Alliance and Dublin Consumers' Gas Company's Lecture Theatre, D'Olier Street, Dublin.

Sept. 8 and 9.—**Combustion Engineering Association :** Conference on the Rational Allocation of Coal, Palace Hotel, Buxton.

Sept. 15.—**North British Association:** Annual General Meeting, Music Hall, George Street, Edinburgh.

DRY COOLING OF COKE

REPORT BY WORKING GROUP OF MINISTRY OF FUEL AND POWER

The Working Group set up by the Ministry to consider the dry cooling of coke has taken evidence from the operators and manufacturers of dry cooling plants in the United Kingdom. In these plants the hot coke from coke ovens or gas retorts is cooled in a chamber through which inert gases are circulated. The heat in the gases leaving the chamber is used to raise steam in a waste heat boiler. Consideration of the evidence obtained has shown the need for standby steam plant, emergency wet quenching arrangements, or adequate standby cooling capacity and certain safety precautions in operating the plant. Evidence, which has sometimes proved to be conflicting, has been collected on the quality of dry cooled coke, its size, ignitibility, and wettability, compared with wet quenched coke. The costs of steam by dry cooling at the existing plants in the United Kingdom have been obtained from which have been estimated the net costs of installing and running dry cooling plants with new carbonising plants. The possibility of recovering the potential heat is influenced by the current shortage of steel, the ability successfully to integrate the carbonising and dry cooling plants, and economic considerations such as the necessity to use all the steam produced.

CERTAIN interim conclusions have been reached. These conclusions are dependent on the present relationship between the cost of capital equipment, labour, &c., remaining substantially as at present, and on the future availability of low grade fuel for steam raising.

Subject to these remarks, the Working Group has reached the following conclusions:—

(a) Dry cooling equipment can give reliable service provided that the plant is adequately maintained. Its reliability as a steam producer is naturally conditioned by the ability of the carbonising plant to furnish steady supplies of hot coke.

(b) In a good many carbonising plants there already exists a considerable amount of integration of the various units constituting the whole, resulting in radically differing circumstances in different works. In examining the application of dry cooling, in consequence, each case needs to be considered on its merits.

(c) For new or existing installations of horizontal and intermittent vertical retorts at gasworks, dry cooling does not show any outstanding economic attraction. Moreover, since for new gasworks installations the choice tends to fall on types of vertical retorts with which the sensible heat in the hot coke is adequately recovered by internal cooling, there seems to be little or no scope for the application of dry cooling in the gas industry, always excepting those large gasworks where coke ovens may come into increasing favour.

(d) The economic advantages and the fuel economy arising from the adoption of dry cooling at new or existing coke ovens, whether used for hard coke production or gas manufacture and for which a steam yield of approximately 1,000 lb./ton of coke cooled may be expected, are sufficient to warrant close consideration being given to the installation of dry cooling plants.

Ford Motor Company, Ltd., Dagenham

The Ford Motor Company's plant at Dagenham possesses the only coke oven installation in this country which is equipped with a dry cooling plant. This was installed by Sulzer, Ltd., in 1931-32, and commenced operation in 1934. It has been described by Mr. Pearson, the plant superintendent, in a paper 'Recovery and Utilisation of Sensible Heat from Hot Coke,' which was presented to the Northern and Southern Sections of the Coke Oven Managers' Association in November, 1946. The plant is located at a fully integrated coke oven plus blast furnace works, where maintenance is of a high standard and where the steam raised can be fully utilised.

The larger sizes of dry cooled coke (>1¼) are employed in the blast furnace and for foundry work and emphatic claims have been made for the dry cooled coke in reducing coke consumption in the blast furnace. It seems possible, however, that certain of the advantages claimed for the dry cooled coke arise from the ability to screen it more precisely than wet quenched coke, with a consequent more uniform charge to the blast furnace. Mere dryness was apparently not an advantage, since water was injected into the top of the blast furnace to keep down the temperature in order to compensate for the absence of moisture in the coke. The operator stressed that moisture can easily be added to the dry cooled coke and that the amount added can be easily controlled.

A point mentioned was that hot coke should not be allowed to fall below the gas inlet louvres, where it cannot be cooled by the circulating gases, and where damage to the cooling chamber can result. Arrangements had to be made, therefore, to place a plug of cold coke in the bottom of the cooling chambers before adding hot coke.

Burnley Gas Undertaking, Oswald Street Works

The Sulzer plant at the Burnley Gas Undertaking's works at Oswald Street was very similar to that at Dagenham, although older and smaller, and it had been designed in conjunction with the horizontal retorts which it served. Although the management regarded the plant as a cheaper means of raising steam than the alternative boiler available, they were not inclined to recommend installation of dry cooling plant because no higher market price could be obtained for the dry coke.

It is significant that at this works, where the cooling chamber capacity was such that both bunkers were only needed when the carbonising plant was under full load, it had proved possible to undertake adequate maintenance to keep the dry cooling plant in such good order that now, when it was just on the point of being fully amortised, it appeared good for many years.

Glasgow Gas Undertaking

The Sulzer bunker type plant, which was very similar to that at Burnley, was installed in 1929. The output of the intermittent vertical chambers with which it was used was such that both cooling chambers were in use all the time; and almost certainly because of this and the inadequate maintenance which resulted, the plant in 1939 was in such a bad state of repair that a complete overhaul was required. It was then shut down for good. The dry cooled coke was again found to command no higher price than wet quenched.

Liverpool Gas Undertaking

Dry cooling of coke was installed at the Eccles Street works in 1930 to assist with the manufacture of a reactive coke, specifically for domestic use, from a blend of coals carbonised in horizontal retorts. The installation consisted of Sulzer chamber type coolers and the time for cooling the coke was only 70 min. In 1933, because of the cessation of gas-making at Eccles Street works, the dry cooling plant was transferred to the Garston Works and was attached to an installation of horizontal retorts whose output was grossly in excess of the capacity of the cooling plant. This interfered with the charging schedule of the retorts, and to avoid this only a proportion of the coke was dry cooled. The plant was dismantled in 1943.

Despite this experience, the management still seemed to be of the opinion that there was something to be said for dry coke, but were inclined to give serious consideration to installing a bunker type of plant which, they emphasised, must be designed for the carbonising plant with which it is to work.

Gas Light & Coke Company, Southall Works

The Sulzer chamber type dry cooling plant was added in 1936-37 to a battery of existing intermittent vertical retorts and site congestion led to unduly complicated and cumbersome coke handling arrangements. Maintenance costs of skips, and labour costs were, therefore, high, and in 1940 the dry cooling plant was shut down. The management were inclined to think that gasworks of 1-2 mill. cu.ft. daily would find the Sulzer type plant too complicated for their standard of maintenance. Difficulties with wetting the coke were referred to and also the dust nuisance, but breeze production was not considered to be higher than for wet quenching.

Stalybridge Gas Undertaking

The plant at Stalybridge is of particular interest as the only example of the Collin dry cooling process in this country and is outstanding in its simplicity in comparison with the Sulzer bunker system. A disadvantage in connection with this Collin plant is that, although a cooling chamber can be easily isolated

for maintenance work, the corresponding carbonising chambers must also be shut down since there is no provision made for discharge of the hot coke other than through the cooling chambers. Gas Chambers & Coke Ovens, Ltd., the British agents of the Colin process are, however, aware of this and intend any future plants to be more flexible by providing a travelling coke car of adequate capacity which can empty the hot coke into any one of the cooling chambers.

EVIDENCE FROM MANUFACTURERS OF DRY COOLING PLANT

Sulzer Brothers, Ltd.

The Company has submitted much written evidence to the Group. It was stated, in this evidence, that the cost of the plant at Dagenham was approximately £45,000 and the present day figure was estimated at £115,000, an increase of 2.5 fold. The Company considered that in a plant like that at Dagenham the provision of a third cooling chamber was desirable as a standby to ensure the provision of a continuous supply of steam and that if there were any likelihood of a stoppage on the coke oven battery of several hours, a steam accumulator or standby boiler was also necessary. Wet quenching facilities were said to be desirable as a standby but need only be of a simple emergency type. The Company admitted that more breeze was produced in dry cooling with the bunker type of plant than wet quenching, but this was not so with the chamber type.

On the question of size of plant the Company said that the smallest plant in existence dealt with 2-3 tons/day. For outputs of coke up to 500 or 600 tons/day, the chamber type plant was cheaper in capital outlay but required more space than the bunker type. Questioned on the reasons for the widespread adoption of dry cooling in Switzerland the Company replied that one of the principal reasons was the high cost of coal in that country—about £10/ton for low grade steam raising coal.

Gas Chambers and Coke Ovens, Ltd.

In an interview with a representative of the Company it was learned that the main reasons why no further Collin plants had been installed since the installation at Stalybridge were the additional complication, the high capital charges, and the loss of revenue due to lack of water in the coke. The need for greater flexibility was realised. Arrangements would be made in future plants so that, in the event of a cooling chamber being shut down for repairs, the operation of the carbonising chambers immediately above need not be suspended.

GENERAL CONSIDERATIONS

Need for Standby Steam Plant

There was no doubt, from the evidence of the operators of the dry cooling plants which have been installed in this country, that they were not prepared to place every reliance on the dry cooling plant as a source of steam. All gasworks operators wished to be sure of an unfailing supply of steam, and, therefore, insisted on the provision of an independent boiler. At Dagenham there were also independent boilers, but the provision of a steam accumulator was suggested as a means of eliminating the need for standby steam plant.

Steam from a dry cooling plant cannot be reliable as a sole source of supply at gasworks and at coke ovens, because the discharging schedule, particularly in the case of old carbonising plants, is notoriously liable to interruption and delay. It is concluded, therefore, that an independent boiler cannot be dispensed with, although it would seem that a smaller boiler capacity could safely be installed than in the absence of the dry cooling plant.

Need for Wet Quenching Arrangements

Another factor on which there appeared to be general agreement among dry cooling plant operators was that provision of some type of wet-quenching arrangements was necessary in order (a) to provide against the contingency of a breakdown in the dry cooling system due to the need for maintenance, and (b) to deal with the high rate of coke discharge on coke ovens after a hold-up. At neither of the two gasworks visited was there such provision, but both managements expressed themselves as desirous of having facilities for handling coke conveniently in the event of breakdown. At Burnley, however, where maintenance of the Sulzer cooling plant was excellent, on only one occasion had it been necessary to resort to water quenching. At Dagenham the normal wet-quenching arrangements were not originally installed, but later, in the light of experience, some emergency wet quenching facilities were added.

At small gasworks, emergency wet quenching presents no real difficulty since the coke quantities are small enough to be manhandled. At larger gasworks and coke ovens, however, adequate arrangements must exist for at least the handling of the coke when the dry cooling plant is out of action for any reason. Whether wet quenching facilities should or should not be added as well depends on whether or not the need for steam requires the installation of sufficient standby cooling capacity to permit of all the coke passing through the remainder of the dry cooling plant while full maintenance is being carried out on any one of its units.

Need for Adequate Standby Cooling Capacity

To ensure adequate maintenance of a dry cooling plant, it must be possible to give the necessary attention without having to interrupt the flow of hot coke from the carbonising plant. Of the Sulzer dry cooling plants examined, only one, that at Burnley, could be regarded as having sufficient reserve cooling capacity to enable maintenance to be carried out easily. In fact, as already mentioned, the plant, although nearly 20 years old, seemed good for many years. It differed, too, from the Dagenham Sulzer plant in having two bunkers each with its own independent gas circulating system, whereas the latter plant, although more recent, had a part of the gas circulating main common to both bunkers, a point which was criticised by the operator. At Dagenham, good maintenance of the dry cooling plant was achieved by having wet quenching facilities also available.

In the case of gasworks, where the load is normally highly seasonal and the summer load may be only 50-75% of the winter, the problem of maintenance is not so serious as at coke ovens, which are non-seasonal in their load except when they are used for gas manufacture or the supply of domestic solid fuel. Access to the interior of cooling chambers for extensive repairs such as relining is possible during the summer period, and the need for standby capacity is in consequence much less. With the Collin system of dry cooling and the Sulzer chamber type, where a number of small cooling units are employed, access for maintenance purposes without interruption of carbonisation is obviously easier than in the Sulzer bunker type where relatively large cooling chambers are employed. The bunker type is according to Sulzer cheaper than the chamber type for units above about 500 tons/day, although this difference may be more apparent than real when allowance is made for adequate standby cooling capacity in the bunker type.

At coke ovens, where the load is non-seasonal, it would appear that the required standard of maintenance of the dry cooling plant can be achieved by the provision of either adequate standby cooling capacity or reasonably complete wet quenching facilities. In the former case the installed cooling capacity should be sufficiently large to permit of at least one cooling unit being on standby all the time. This will not necessarily eliminate, however, the need for independent steam plant and emergency wet quenching facilities. In the latter case, the closing down of one cooling unit for maintenance will cause a reduction in steam output which will have to be made good by the independent boiler.

It is concluded, therefore, that at gasworks the dry cooling plant should be large enough to deal with winter peak loads and its design should be such that at least one cooling unit will be available for maintenance during the summer period, and that at coke ovens the decision as to whether standby cooling capacity or reasonably complete wet quenching facilities should be installed is conditioned by the importance ascribed to the steam supply from the dry cooling plant.

Need for Safety Precautions

From the very nature of the dry cooling process whereby a gas mixture originally based on air is circulated through red hot coke, there is a potential danger of the formation of explosive gas mixtures. An added risk arises if any undercarbonised coke still containing volatile matter is charged to the cooling chamber. From the evidence of operators of dry cooling plants it was clear that minor 'pops' had been experienced but that the explosion doors fitted to the plants had prevented serious damage. Proper maintenance of the circulating gas mains is obviously required to avoid serious inleak of air, although absolute gas-lightness of the plant is not to be expected nor is it considered desirable by Sulzer, who contemplated without apprehension some leakage in order to take care of the rise in pressure due to heating of the circulating gas after introducing a charge of hot coke into a bunker, and of the fall due to the subsequent cooling. At Burnley, where 'black ends' from horizontal retorts were occasionally charged, the bunker was left open for some minutes after charging to permit of the burning-off of these ends.

Another potential source of danger in dry cooling is leaking of steam or water from the boiler into the circulating gases with the possibility of the formation of water gas by reaction with red hot coke. At one plant, where proper conditioning of the boiler feed water was not carried out in the early days of the dry cooling plant, pinholing of the boiler tubes ensued. Proper water condition is, of course, a necessity with any boiler.

The question of the necessity for taking samples of the circulating gases to detect the presence of oxygen from air leaks of a serious extent or of combustible gases is debatable. On the

whole it would seem advisable to make daily checks in order to assist the discovery of newly arising leaks which will in most cases be noticed from other indications, or to install a recorder. Explosion doors must, however, be incorporated at appropriate points as a matter of course.

QUALITY OF DRY COOLED COKE

The evidence obtained from operators regarding the quality of dry cooled coke has been variable and sometimes conflicting. At only one works, Dagenham, were substantial claims advanced for an enhanced value of dry cooled coke as compared with wet quenched and these related largely to the use of the coke in blast furnace practice. For other purposes the value of dry cooled coke can be summarised in the statement made by more than one operator—'No higher price is obtained in the open market for dry cooled coke than for wet quenched.'

It is quite generally agreed that the absence of moisture in dry cooled coke enables precise screening into graded sizes to be carried out, particularly as regards the separation of breeze $<\frac{1}{4}$ in. from the larger sizes. Moreover, it is possible to separate cleanly breeze $<\frac{1}{4}$ in. into $\frac{1}{2}$ in.$-\frac{1}{4}$ in., $\frac{1}{4}$ in.$-\frac{1}{8}$ in. and $<\frac{1}{8}$ in., if necessary and if a market for any of these particular sizes can be found at a higher price than ordinary breeze. As a fuel for slow combustion stoves $\frac{1}{2}$ in.$-\frac{1}{4}$ in. coke is particularly valuable. With wet quenched coke such separations are virtually impossible.

It does not appear, on the limited evidence available, that dry cooling is leading to much enhanced breeze production, a view in agreement with the literature on the subject. The impression that dry cooling leads to the production of more breeze than wet quenching is probably due to the ease of separation of dry cooled breeze from the larger sizes.

At Dagenham, it was stated, and inspection confirmed, that the general size of the dry cooled coke was smaller than to be expected from wet quenching, although it was said to be harder, and figures for screen-analysis, shatter, and tumbler tests were advanced which supported this contention. The differences, however, were not large in the case of the latter two tests. These somewhat better results and the smaller size of dry cooled coke were in part ascribed to the mechanical treatment received by the coke in being tipped into the bunker and its subsequent passage through the bunker and discharging arrangements.

There is no doubt that the ease with which dust was disengaged from dry cooled coke during handling and particularly screening operations was objectionable. Light spraying of the dry cooled coke was, therefore, practised at certain works (Liverpool, Southall, Stalybridge, &c.) to reduce the nuisance, which had led to the complete enclosure of the screens and provision of dust extraction arrangements at Dagenham.

Ignitibility of Coke

In general, the consensus of opinion was in agreement with the literature that dry cooled coke was less easily ignited than wet quenched coke, although one operator (Southall) stated that the object of installing the dry cooling plant was to improve the reactivity of the coke from his intermittent vertical chambers. Likewise, at Liverpool, the object of spraying the dry cooled coke was said to be not only to keep down dust, but also to prevent ignition due to its reactivity.

Utilisation

In general, coke from dry cooling processes in this country has been put to the normal uses for which wet quenched coke has been employed. At Dagenham, the sizes 1¼ in.—4 in. and >4 in. are employed in a blast furnace and foundry. Much discussion has taken place in the technical literature and at meetings on the claim made on behalf of the plant at Dagenham that the use of dry cooled coke has resulted in very substantial savings of coke in the operation of the blast furnace.

There is no doubt that at 14.7 cwt. of coke per ton of iron the consumption of coke is exceptionally low even when allowance is made for the low moisture and consequent high carbon content of the coke. Other blast furnace operators are certainly prepared to contest the claim that this is entirely due to the use of dry cooled coke.

Wettability

To resolve a divergence of views on the subject of wettability, arrangements were made by the Director of Fuel Research, at the request of the Ministry, to carry out investigations at Burnley and Stalybridge. These showed:—

(1) That dry cooled coke from either horizontal or intermittent vertical chambers can be wetted to an extent adequate for all normal purposes.

(2) If dry cooled coke is allowed to cool to atmospheric temperatures the amount of water which it will take up (at least 10%) is appreciably lower than if the water were added with the coke at the temperature of discharge from the carbonising plant (more than 25%) or at that from the dry cooling chamber (at least 20%).

(3) After storage in the open for several months, dry cooled coke could contain 8-16% of water, dependent upon size.

It is clear, therefore, that there should be no difficulty in adding sufficient water to dry cooled coke, if necessary, for reasons such as allaying dust.

For coke ovens having a non-seasonal load, figures show that the case for the installation of dry cooling is strong enough to warrant consideration whether the yield is taken as 750 or 1,000 lb. of steam per ton of coke. Even when the marginal cost (*i.e.*, exclusive of capital cost) of steam raising at a very large boiler is considered, the balance is in favour of dry cooling and markedly so when emergency wet quenching facilities are installed as an alternative to standby cooling capacity. Since with coke oven installations no such possibility exists as with gasworks for exercising fuel economy by installation of a different type of carbonising plant, the interests of fuel economy combine with the purely economic aspect to reinforce the argument.

Coke Ovens at Gasworks

It is known that, at a large gasworks where extensions have recently been made to the coke ovens, consideration was given to the idea of using dry cooling. The Group was informed that, in view of the general position regarding new constructional work, it was not considered opportune to install dry cooling plant at the present time. Space had, however, been left so that it could be installed if subsequent review showed it to be desirable.

Existing Coke Oven Installations

There can be financial benefit from installing dry cooling at a new coke oven plant and there may well be existing coke oven plants, already possessing full wet quenching facilities, where the addition of a carefully integrated dry cooling plant can also provide a profit. In view, however, of the existing wet quenching facilities and boiler capacity for steam raising, it would appear that the inclusion of standby cooling capacity will be ruled out on economic grounds.

The case considered below is, therefore, of a two bunker dry cooling plant with no standby cooling capacity, the existing wet quenching facilities and, if necessary, the original boiler system being called into operation when maintenance becomes necessary on the dry cooling plant.

COKE OVEN PLANT WITH A THROUGHPUT OF 700 TONS OF COKE/DAY.

		£
Capital cost of dry cooling plant		120,000
Annual charges: Capital (20 years at 5%) ...		9,628
Additional labour		4,600
„ maintenance ...		3,500
„ power		6,000
		23,728

Total steam production per annum:
Case A. (750 lb./ton coke cooled) 191,600,000 lb.
Case B. (1,000 lb./ ton coke cooled) 255,500,000 lb.

In comparison with all the types of independent boiler considered, and the range covered is fairly comprehensive, there would be a profit accruing to the dry cooling plant, and this can be appreciable when the steam output is in the region of 1,000 lb./ton of coke cooled, which the experience at Dagenham is considered to justify.

In the present consideration of the economics of dry cooling, the implicit assumption is made that the whole of the steam available can be efficiently consumed, either in the works or in its immediate neighbourhood. Naturally, if this is not the case, the whole position must be reviewed in the light of existing local circumstances, which in any case, particularly local fuel costs, will greatly influence the final decision.

A factor which will need to be taken into account is the potential market value of dry cooled breeze. It is possible that the ability readily to separate such breeze by screening will make available for sale, at an enhanced price, a proportion of small coke which would otherwise command only breeze price. Thus at Dagenham, of the breeze $<\frac{3}{8}$ in. at present being produced, which amounts to 13.6% of the coke, the $\frac{3}{8}$ in.-$\frac{1}{4}$ in. size represents about 60%. Hence 1 ton of coke gives 0.136 ton of breeze containing 0.082 tons of $\frac{3}{8}$ in.-$\frac{1}{4}$ in.

	s.	d.
Now, value of 0.136 ton breeze at 35s./ton = ...	4	9
„ „ „ 0.082 „ $\frac{3}{8}$ in.-$\frac{1}{4}$ in. at £3 10s./ton =	5	9

Gain: 1 0 per ton of coke.

In general, using the above prices, if the yield of $\frac{3}{8}$ in.-$\frac{1}{4}$ in. is more than about 45% of the breeze, a profit will accrue from its separation by screening, although this calculation ignores screening costs, against which, however, may be set the value of the breeze below $\frac{1}{4}$ in. If breeze prices tend to fall as they may well do, the above gain will probably increase.

ECONOMICS OF THE GAS AND ELECTRICITY INDUSTRIES *

NEW OPPORTUNITIES FOR CO-ORDINATION

By L. J. CLARK, B.E.M., M.Sc.

North Thames Gas Board

ALTHOUGH the demand for electricity (Fig. 1) has increased by nearly 800% since 1920, the actual increase in thermal output is only about one and a half times the corresponding increases in gas output over the same period and this is of particular interest, when it is remembered that gas had been available for more than a century prior to 1920 and its fields of application may well have been considered to be approaching saturation. Further, it may be seen that the thermal output of gas at the present time is more than one and a half times that of electricity and if the combined therms of gas and coke are taken into account, the gross output is over four times that of electricity.

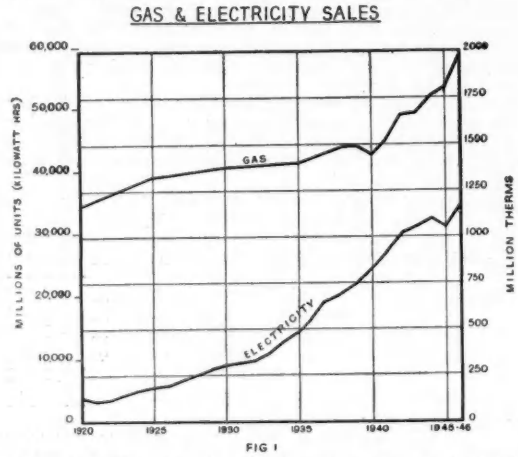


FIG 1

With such rapid expansion in the use of gas and electricity, one may well wonder how much longer such growth may be expected to continue before market saturation is reached. In this connection it is of interest to note from the Simon report that of the fuel consumed by domestic premises in 1938 gas and coke supplied 10% and 6% respectively, electricity 4% and coal 80%, which would appear to indicate that far too much raw coal is being burnt inefficiently in stoves and open grates, producing atmospheric pollution of our cities and unnecessary labour in the home.

Fig. 2 shows the changes of annual coal consumption for electricity generation, gas production and direct domestic utilisation and it is significant to note how the later consumption has fallen by more than 25% during the last eight years. This has in some measure been caused by domestic coal rationing and also by narrowing of the relative price ratios between alternative fuels, following the considerable increases in the cost of coal during recent years. If the falling demand for domestic coal is maintained, it seems likely that the gas industry may be able to secure a considerable proportion of this important load.

Efficiency in Manufacture

Turning to the subject of efficiency, it is well known that coal can be converted into gaseous energy much more efficiently than into electrical energy, although in the sphere of utilisation, the advantage usually passes to electricity.

In expressing the efficiency of gas manufacture, the coke and other by-products are offset against a corresponding thermal equivalent of the coal, leaving the net coal figure to be related to the gaseous yield for evaluating the efficiency of gas production, these figures are reasonably high, an examination of the various component efficiencies and sources of loss, shows that there are and this usually lies in the range from 45% to 60%. Although many possibilities for further improvement and it is not unreasonable to expect that the internal losses incurred in gas production can be reduced to half their present figure by development in plant design and operating technique.

The efficiency of electric power generation is of a much lower order, the best base load power stations at the present day giving an overall thermal efficiency slightly in excess of 30%, while the average efficiency of all stations in the country is little more than 20%. Although these efficiencies are not high, considerable improvements in performance have been effected during the last 30 years, for whereas the overall efficiency of all generating stations in this country was 8.3% in 1920, this figure had risen to 20.8% in 1939. Subsequent progress has, however, been small and it is now generally accepted that optimum conditions have been nearly reached and so long as the steam turbine continues to be used as the principal type of prime mover, little further improvement can be expected.

No spectacular improvements have been achieved with gas manufacture, although progress has been steady and during the past 30 years the overall efficiency of gasmaking has been raised by about 6%, which would seem to indicate that, after 120 years of development, the industry is still very much alive to the possibilities of increasing technical efficiency still further.

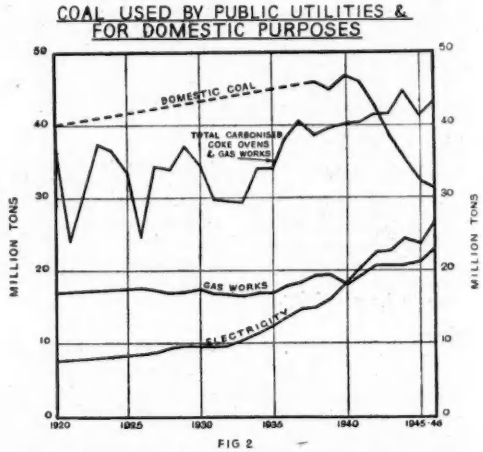


FIG 2

The thermal efficiency of the retort house is influenced by three main factors, which are (a) the carbonising temperatures and cracking conditions within the retorts, (b) the degree of gas leakage within the setting and (c) the fuel consumption of the producers.

Fruits of Accumulated Knowledge

The accumulated knowledge of the mechanism of carbonisation has led to improvements in the designs of retorts and heating systems, so that higher gas yields can now be obtained with a minimum degradation of the richer hydrocarbons. The assessment of these values has been aided by Dr. Pexton's concept of the Hydrocarbon Enrichment Value which, as its name implies, provides a measure of the quantity and richness of gaseous yields.

Gas leakage from retorts has also been reduced by fuller appreciation of the expansion effects, the stability of refractory structures operating at high temperatures and the adoption of compensated or sprung bracings. The introduction of air borne sealing has also produced beneficial effects in reducing leakage from vertical retorts and with good operating practice this figure should not exceed 2 to 3 therms per ton.

The most important single factor affecting the efficiency of

* From Presidential Address to the London and Southern Junior Gas Association, June 10, 1949.

retort settings is the fuel consumption of the producers. Now it has been found that there is a negligible change of sensible heat when coal is carbonised at high temperatures, so that all the fuel consumed by the producers is merely required to make good the various losses from the setting. These may be classified as (a) the sensible heat carried away in the hot gas and coke leaving the retorts, (b) the radiation loss from the setting, (c) the heat carried away in the waste gases after providing for recuperation to the secondary air, (d) the heat absorbed in the production of blue water gas, if steaming is practised and (e) the losses entailed in making producer gas.

An analysis of the heat losses for each of the four main carbonising systems is illustrated diagrammatically in Figs. 3 to 6. These show clearly the characteristics of each system and they indicate possible lines for future improvement. They are based upon operating results for modern plants carbonising Durham coals, as quoted by Dr. Pexton in his paper† to this Association in 1943, and the figures given represent heat quantities, expressed as a percentage of the potential heat in the coal carbonised. The recoverable waste heat steam is also shown.

RECUPERATIVE HORIZONTAL RETORTS

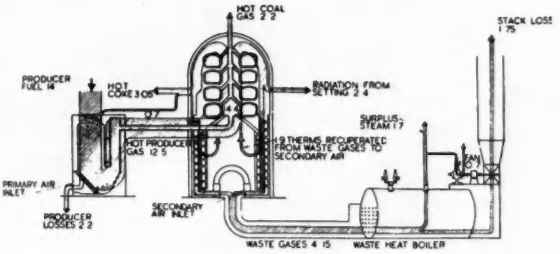


FIG 3

I do not propose to review these diagrams in detail, as they are in the main self explanatory, but for ease of comparison Fig. 9 has been prepared, which sets out all the losses for each system in block form, thereby facilitating direct comparison.

The total fuel consumptions are shown to be:—

Coke Ovens	10.9%	of the therms in the coal
Continuous Vertical Retorts...	11.3%	,, ,,
Intermittent Vertical Chambers	13.0%	,, ,,
Horizontal Retorts	14.0%	,, ,,

INTERMITTENT VERTICAL CHAMBERS

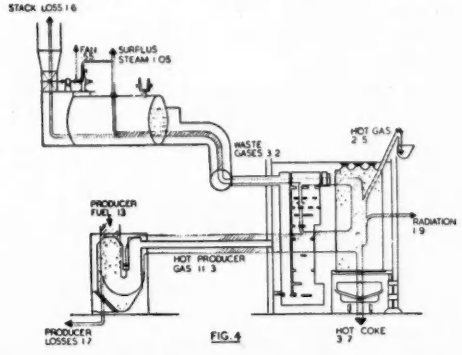


FIG 4

It is appreciated that these figures may vary considerably according to the design, age and method of operating the plant and it is known that there are many installations now at work having fuel consumptions exceeding 20%.

Future Improvements

There is little opportunity for improving materially the fuel consumption of horizontal retorts, but in the case of intermittent vertical chambers and coke ovens, the application of dry coke cooling appears attractive. This system has been extensively applied in Switzerland, where more than 80% of the coke produced is cooled in this way. In this system the hot coke is discharged into containers at a temperature of 950-1,000°C. and these are placed within closed chambers and cooled by irert gases, which are circulated through a waste heat boiler by means of a fan. The coke is thereby cooled to a temperature of 250°C., and some 60% of its initial sensible heat is recovered as useful high pressure steam.

The continuous vertical retort appears to offer the greatest opportunities for improvement and a possible target for a future installation is indicated in Fig. 9. Considerable improvements in

CONTINUOUS VERTICAL RETORTS

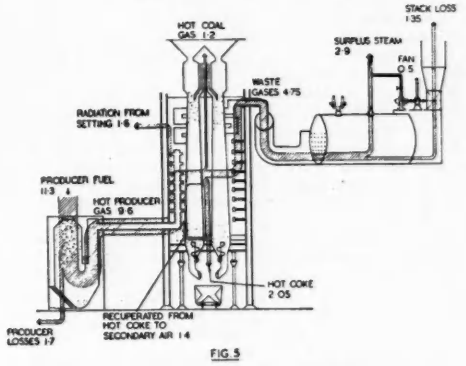


FIG 5

ALL FIGURES REPRESENT HEAT QUANTITIES EXPRESSED AS A PERCENTAGE OF THE HEAT IN THE COAL CARBONIZED

this direction have already been achieved in the most modern plants, by modifying retort designs to give more uniform coal travel, and in this way a fuel consumption of less than 10% has been attained when carbonising graded Yorkshire coal. It is appreciated that the type of coal has an important influence upon this result, since a freely travelling coal will usually give lower gas offtake temperatures and greater throughputs in relation to the radiation losses, which remain constant. Other improvements may be effected by increasing heat transfer at the base of the retorts, thereby reducing the coke discharge temperature from about 650°C. to 450°C. and the consequent loss to 1.4%. Radia-

COKE OVENS

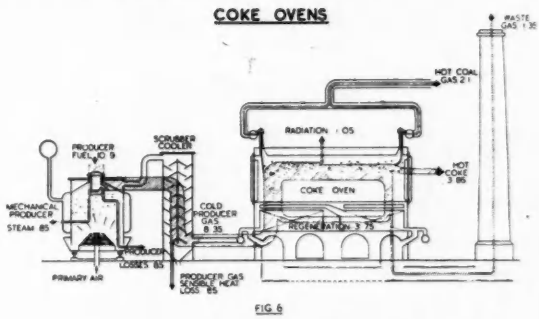


FIG 6

ALL FIGURES REPRESENT HEAT QUANTITIES EXPRESSED AS A PERCENTAGE OF THE HEAT IN THE COAL CARBONIZED

tion may be further reduced by improved insulation and the loss brought down to 0.8%. There is also the possibility of recuperating a limited amount of heat from the waste gases, by interchange with the primary air supplied to the producers.

Satisfactory experience has been gained in Switzerland with pre-heat air temperature of about 150°C., employing heat recovery in a dry coke cooling system. Other possibilities for using even higher pre-heat temperatures for the primary air are suggested by the application of slaging producers or the use of a high degree of steam saturation which would counteract excessive grate temperatures, by initiating the endothermic water gas reaction.

With such possibilities in view it may well be practicable to effect a material reduction in the fuel consumption of continuous vertical retorts, to a gross figure of about 7% of the heat in the coal. If such savings could be achieved, more than 1½ mill. tons of fuel could be saved annually by the gas industry.

An interesting possibility for improving waste heat recovery from retort settings is suggested by the application of the gas turbine. The closed cycle or 'aerodynamic' machine is particularly well suited for this duty, as its indirect air heater can deal with dust laden waste gases which are available at a suitable temperature of 850-900°C. These gases would leave the turbine air heater at about 550°C. and pass to a waste heat boiler for

† Fuel Requirements of Carbonising Plants, S. Pexton, D.Sc., Ph.D., paper to the London and Southern Junior Gas Association, January, 1943.

further recovery. In this way a gross electrical power output of about 50 kWh. per ton of coal could be obtained, together with sufficient low pressure steam for process requirements in the retort house. The gross power thus generated would be nearly 50% higher than that obtainable with the conventional steam system.

Carburetted Water Gas

Although carburetted water gas has been used as an auxiliary to coal gas for many years, its full economic significance in relation to seasonal and peak load requirements does not appear to have been fully appreciated until more recent years. This has led to a general increase in the use of carburetted water gas which has been accelerated by the necessity to meet rapidly increasing demands for gas and by the restrictions imposed on coal gas plants consequent upon shortages of coal and refractory materials.

In the case of continuous vertical retort gas with a declared calorific value of 500 B.Th.U./cu.ft., the necessary water gas can be efficiently produced by internal retort steaming. Some base steam is always necessary to prevent overheating of the coke extractors and so long as this steam is not excessive, heat may be recuperated from the descending coke charge and water gas can be produced at a high efficiency equivalent to 200 therms per ton of fuel.

For other carbonising systems, the diluent blue water gas is most efficiently manufactured in a separate plant, which provides the double advantage of great flexibility and high thermal capacity for meeting peak load requirements.

Blue Water Gas

The heat flow diagram for a blue water gas set is shown in Fig. 7 and it will be appreciated that this differs from the previous diagrams for carbonising plants, as the coke supplied to the generators not only provides heat for the process, but also carbon

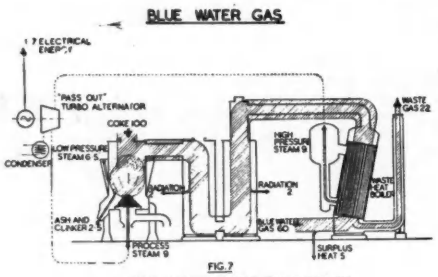


FIG. 7

HEAT BALANCE FOR PRODUCTION OF BLUE WATER GAS. FIGURES ARE BASED UPON 100 UNITS OF FUEL INPUT

for gasification, and for simplicity the heat balance for these combined processes is shown. It will be noted from the diagram that a gross input to the generator of 100 thermal units of coke and 9 units of steam will yield 60 potential heat units of blue water gas plus 15.5 units of steam. For most existing plants, this steam is insufficient for the power and process requirements and a make-up quantity varying between 5 and 10 units may be required. This make-up steam would necessitate the combustion of some 7½-15 units of fuel under the boilers, so that the total fuel consumed in the production of 60 units of gas would vary from 107.5 to 115, thus giving an overall efficiency ranging from 52% to 56%.

This position can be considerably improved by so co-ordinating the steam and power requirements that the high pressure waste heat steam is initially expanded through turbines driving the blowers and exhausters and subsequently used for supplying the process in conjunction with low pressure steam from the generator boiler. In this way the entire water gas plant can be made self supporting in steam and the overall efficiency thereby raised to 60%.

It will be appreciated that the problem is complicated by the fact that the production of waste heat steam is cyclical and non-coincident with the demands of the process and the power plant. This, however, can be overcome by incorporating a low pressure steam accumulator of sufficient storage capacity to smooth out the intermittent nature of the supply and demand, and plants incorporating these features are now under construction.

For large plants, a further improvement may be obtained by passing all the waste heat steam through a 'pass out' or back pressure turbo-electric generator, exhausting steam to the process though an accumulator and supplying electricity to motor driven blowers and other ancillaries. This arrangement possesses the advantage of employing one large turbine of high efficiency and an electric generator which can be run in parallel with the works supply, thereby providing a means of balancing the load and conserving surplus electrical energy which would be available from the water gas plant under certain conditions.

There are several other possibilities for improving the efficiency of the water gas process and it may well be that efficiencies exceeding 70% may be attained as a result of investigations which are being made along the following lines:—

(a) The employment of higher steam air ratios which have been shown by Dr. Dent to give greater yields per unit of coke consumed and higher outputs from the generator.
(b) The use of higher blast pressures to the generator thereby reducing the blow gas losses.
(c) The employment of preheated blast air, by heat recuperations from the exit blow gases.
(d) By the use of higher steam pressures for the boilers, thereby increasing the available power.

When considering the production of carburetted water gas for peak load purposes, the heat flow diagram takes a different form as shown in Fig. 8. It will be noted that when manufacturing gas at 500 B.Th.U./cu.ft. 55 units of thermal input are derived from coke and 45 units from oil. The losses associated with the generator are decreased in proportion with the coke demand. There is also a loss of 11 units in residual tar from the oil cracking process, leaving 62 units of potential heat in the gas.

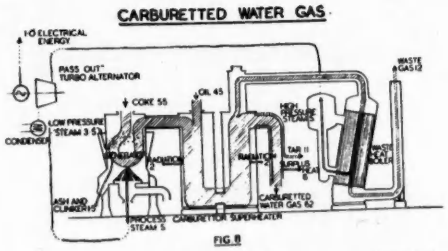


FIG. 8

HEAT BALANCE FOR PRODUCTION OF CARBURETTED WATER GAS (500 B.Th.U./CU.FT.) FIGURES ARE BASED UPON 100 UNITS OF FUEL INPUT

The oil is cracked at a high efficiency and as the tar is a good quality boiler fuel, it may be credited against the coke input when assessing the overall efficiency of the process. This is, therefore, shown to be $\frac{62}{100-11}$ or 69.6%.

By improving the efficiency of blue gas manufacture on the lines indicated earlier, it may be possible to raise the overall efficiency of carburetted water gas production to 74%.

Overall Gasworks Efficiency

It may be concluded from the foregoing analysis that coal and coke can be converted into gaseous energy at a high efficiency, but in arriving at the overall position of the entire gasworks a number of secondary processes must be considered and these consume power and incur other losses which adversely affect the overall efficiency.

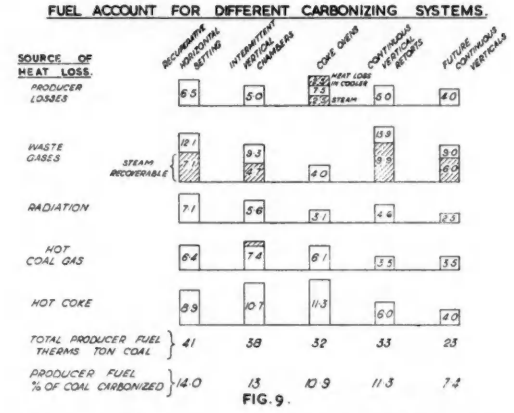


FIG. 9.

A typical heat balance for a group of fairly large gasworks incorporating all systems of carbonisation is shown in Fig. 10A. This represents average conditions during a period of six months, when the carburetted water gas content excluding blue water gas for dilution was 20% of the mixed gas.

It will be noted that from 100 thermal units of coal, 46.45 units appear in the residual coke, tar and breeze, and these may be offset against an equivalent proportion of coal, leaving 53.55 heat units of 'net coal' to be debited to the production of 27.95 thermal units of gas, thus representing a coal gasification efficiency of 52%.

In addition to the 100 units of coal carbonised, 4.5 thermal units of oil were converted into 3.3 units of oil gas and 0.7 units of tar. By summation of these values, the overall gasification efficiency from coal and oil becomes 54.4%.

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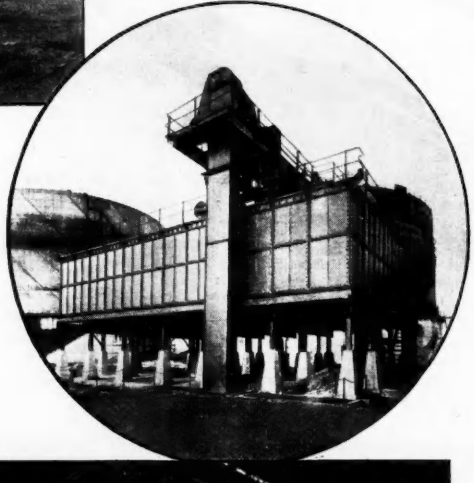

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It is, however, appreciated that this figure will vary considerably from one works to another, depending upon the type of carbonising plant employed and the general steam and power balance. For the group of works referred to in Fig. 10A, the range of overall efficiency lies between 45% and 59%, representing the difference between small works with horizontal retorts and an intermediate size works with modern continuous vertical retorts. Of particular significance in Fig. 10A is the overall fuel consumption of the works, representing 25.7% of the therms in the coal received and for convenience this has been sub-divided into its constituent losses, of which steam raising appears as an appreciable item accounting for 5.3% of the heat in the coal.

The efficient use of steam and power on the gasworks has an important bearing upon the overall efficiency.

PRESENT & FUTURE HEAT BALANCES FOR GAS MANUFACTURE

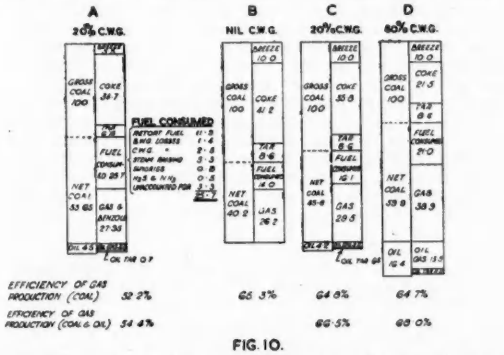


FIG. 10.

On the average existing works, the gross thermal demand for steam, expressed as a percentage of the therms in the coal, varies from 4.5 to 6.5% and this may rise much higher on inefficient works. If, however, complete electrification is adopted for all mechanical drives, and all steam raised is supplied direct to a 'pass out' engine or turbo generator, the process and heating requirements can be supplied after the steam has done useful work in the turbine and the gross thermal demand for steam on the works can thereby be reduced to 3.0 to 3.5% of the therms in the coal, which percentage would fall within the proportion of waste heat steam normally recovered from a continuous vertical retort installation. The electricity generated would amount to about 25-33% kWh per ton of coal, depending upon the waste heat boiler pressure adopted, and this electricity would be more than sufficient for the average requirements of a fully electrified works, which would normally amount to 18-22 kWh per ton.

The Gas Turbine

If the gas turbine were adopted for waste heat recovery in conjunction with a steam boiler, from 40 to 50 kWh. per ton could be obtained. It follows, therefore, that considerable quantities of surplus power could be made available to the electric supply industry and although the greater proportion would be available at night, it would lead to a direct saving of coal at the power station.

In the case of static systems of carbonising, the proportion of electricity generated from waste heat steam would be less and it would be necessary for a supplementary supply to be purchased from the public mains. In negotiating for such supplies, with the British Electrical Authority, considerable advantage can be obtained by arranging for the works generators to run in parallel with the public supply, thus giving flexibility in balancing the loads.

It is, therefore, evident that most gasworks could effect considerable economies by the use of higher steam pressures and the modernisation of their steam and power systems, especially by the conversion of small and widely dispersed steam power units to electric drive and at the same time curtailing the steam distribution system to an absolute minimum, for small straggling steam services are the cause of considerable loss.

In order to obtain the full advantage of electrification, it is important that mechanical plant such as conveyors, pumps, gas boosters, &c., are carefully selected after full consideration of the working conditions. So frequently it is found that machines are overpowered or have an excessive margin of capacity and therefore run inefficiently under normal condition.

It is of interest to see the influence of a co-ordinated steam and power system upon the overall efficiency of a gasworks and Figs. 10B, C, and D indicate the thermal balance that may be obtained for a works equipped with modern continuous vertical retorts, a self supporting water gas plant and a co-ordinated steam and power system.

Fig. 10B shows the conditions when manufacturing unstripped coal gas, diluted to the declared calorific value with blue water gas. No fuel is required for steam raising and the coal gasification efficiency is shown to be 65.3%.

Fig. 10C shows the conditions when producing mixed gas containing 20% of carburetted water gas and in this case the coal gasification efficiency is 64.8% and the coal plus oil gasification efficiency 66.5%.

Fig. 10D shows the conditions when producing a mixed gas containing 50% of carburetted water gas, when the gasification efficiencies become 64.7% and 68% for coal alone and coal plus oil respectively.

These efficiencies represent a considerable advance over the actual results indicated in Fig. 10A, but it is appreciated that they would not apply in such magnitude to those works equipped with static systems of carbonisation, since the intrinsic efficiency of the carbonising units is not so high and there would be an insufficiency of waste heat steam to supply a completely modernised steam and power system. This latter condition, however, could be changed by the introduction of dry coke cooling, by which means some 60% of the sensible heat in the hot coke discharge can be recovered as high pressure steam and it will be noted from Fig. 9 that the total waste heat steam production including dry coke cooling would in most cases be higher for the intermittent than for the continuous carbonising systems.

It is of interest, also, to note from Figs. 10B, C and D how the proportions of gas and residuals change with increasing proportions of carburetted water gas and it is evident that when the proportion of carburetted water gas is raised to approximately 65%, all the coke will be consumed for gas making.

The quantity of breeze produced from the retorts is considerably higher than the average actual percentage indicated in Fig. 10A, since nearly half the breeze made is at present consumed internally as a fuel for the boilers. In the idealised cases represented in Figs. 10B, C and D, no direct fired steam is considered necessary and all the breeze is available for sale or for some other internal use.

In order to maintain satisfactory control over the breeze market, it is desirable that a proportion of this fuel should be consumed on the works, provided this can be achieved efficiently and economically.

Economics of Gas Manufacture

From the considerations so far reviewed, it may be concluded that although the thermal efficiency of the gas manufacturing process is of a high order, there are many possibilities for future development.

It must be appreciated, however, that efficiency alone is not the final criterion, for it can only be achieved at a price and the extent to which it is worth pursuing is determined entirely by economic considerations. The gas industry has progressed to its present standing through its ability to provide a heat service at an economic and competitive price, and it may be of interest to review some of the principal economic aspects involved.

It is known that the market values of the products of carbonisation (when assessed on a thermal basis), vary appreciably, and if the value of a therm of coal is taken as 1.0 the individual main products, comprising benzol, gas, tar, coke and breeze will vary in descending order over a range from about 5.0 for benzol to 0.6 for breeze. It follows, therefore, that the economic balance of any system of carbonisation will vary according to the net products obtained. By a combination of different gas making processes, the proportions of gas and coke made can be varied within the wide limits up to the extent of complete gasification.

In general it may be stated that the continuous vertical retort produces the highest yields of tar, coke, breeze and waste heat steam, but that for reasons already discussed, the straight coal gas yields are not so high as those obtained with static systems of carbonisation. By analysing the net quantities of gas and residuals from the different systems of carbonisation (when operating with similar coal) and ascribing appropriate factors for the market values of each residual, the net coal value chargeable to the known thermal yield of gas can be determined and compared. It is interesting to note, that when appropriate allowances are made for waste heat steam and coke required for diluent blue water gas, the costs per therm of gas for modern carbonising plants representing the four systems are within 12% of one another and they occur in the order of continuous verticals, coke ovens, intermittent verticals and horizontals, the latter representing the highest costs.

When the analysis is taken a stage further and the complete charges for production wages, stores, maintenance, overheads and capital are included, the coke ovens show up to advantage, as they incur lower labour and maintenance charges. The final relative costs of gas production, with coke ovens taken as 100 are, therefore, shown to be:—

Coke ovens	100	Units of cost per therm
Continuous vertical retorts ...	106.7	,, ,,
Intermittent vertical retorts ...	107.1	,, ,,
Horizontal retorts	114.8	,, ,,

It is therefore evident that the relative difference in the production costs of the four main systems, assuming modern plants with a high standard of operation, is not so very great, and if coke ovens are excluded as a special case only to be considered

in very large units carbonising more than 800 tons of coal per day, the difference between the other three systems is within a range of 7% or about ½d. per therm of actual production cost at current price levels.

This small difference, coupled with the inherent advantages of the static systems in their flexibility and ability to carbonise a wide range of coals, would appear to indicate that all four carbonising systems will hold a place in the gas industry for many years to come.

Considerations of Load Factor

It is well known that the economics of any manufacturing process are affected considerably by the load factor of the demand. In the gas and electric supply industries the load factor is of great importance, although its influence upon the operation of the production plant is very different in each case. In the gas industry there is usually sufficient storage capacity to smooth out variations of demand within the day and also weekends, so that in this case, the output of the manufacturing plant has to respond only to the average daily changes of demand, while the hour by hour variations of load have only to be met by the pumping plants and distribution systems.

The largest single component of load supplied by the gas industry is that required for cooking purposes. This is a very heavy load, and in the case of the London area represents slightly more than 50% of the total gas demand. If this percentage is taken to be representative of the whole country, the total cooking demand will be equivalent to about 85% of the total therms in the electricity at present generated.

The space heating load of both industries is a little over 20% of their total thermal outputs and it would be reasonable to expect that the characteristics of the actual hourly demands for that portion of the load which is associated with normal variations of seasonal temperatures would be similar, giving a load factor of 30% when determined on an hourly basis. For the gas manufacturing plant, however, this is appreciably improved by the effect of storage to about 46% and although this advantage is not so great as in the case of cooking, it produces a load which is favourable for gas.

The most uneconomic type of load to be met by the gas industry is that created by those space heating appliances which are only required for 'topping up' purposes, or very occasional use in extremely cold weather. The load factor of these appliances is not likely to be higher than 3% and they are a source of embarrassment to both the gas and electric supply industries, for the cost of supplying such loads is out of all proportion to the revenue received.

Distribution

The costs incurred in the distribution of either gas or electricity are considerable, as a large proportion of the total capital investment of these public utilities is associated with the distribution mains and allied equipment. In the case of electricity, the distribution charges amount to about 40% of the consumer cost and most of this is represented by fixed capital charges.

In the case of gas, the capital costs of the distribution mains and services are relatively lower and the charges so incurred usually represent less than 20% of the cost to the consumer.

A comparison showing the approximate sub-divisions of the gross capital assets for the gas and electricity industries, in relation to their thermal capacity is given in Table I.

TABLE I.

	Gas.	Electricity.	
	£/Therm/Day on Installed Capacity.	£/K.W. Installed Capacity	£/Therm/Day Installed Capacity.
Manufacture	13.5	17	21
Distribution	11.8	32	39
Miscellaneous, including services	7.7	16	20
Total	33.0	65	80

These figures are only intended to show the approximate relationship between the two industries, and it will be appreciated that current replacement values will be two to three times higher than the figures shown.

They do, however, serve to show that the gross capital charges per therm of installed capacity are likely to be about 2½ times higher for electricity than for gas, while the relative difference between the distribution charges is likely to be ever greater.

When comparing long distance transmission, however, electricity has a considerable advantage, for the use of overhead lines operating at extra high voltage, result in much lower labour and material costs for installation, and the high pressure or voltage can be obtained with only a small loss in the transformers. In the case of gas, high pressure transmission does not offer such great advantages, for higher operating pressures require thicker walled pipes, which partially offset the saving in material weight due to reduction of the pipe diameter.

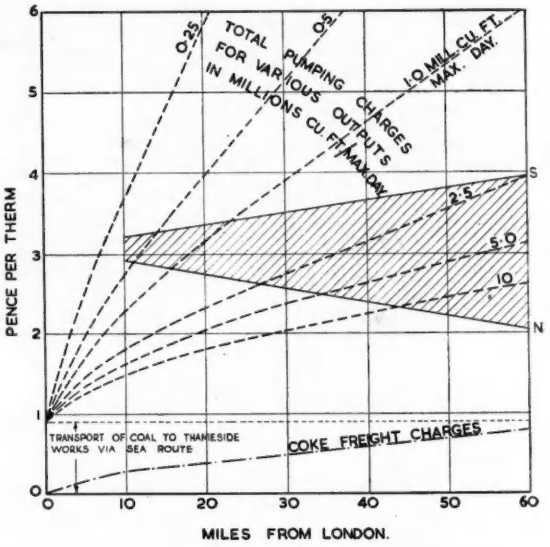
A typical overhead grid line operating at 132,000 volts and transmitting up to 200,000 kW. would cost about £3,500 per mile to install.

This transmission capacity would be approximately equivalent to a 24 in. high pressure gas main transmitting 30 mill. cu.ft./day at an initial pressure of 50-60 lb. per sq. in. for which the installation cost would be about £18,500 per mile or five times the electrical equivalent. It is interesting to note, however, that although some 3,000 horsepower would be required to pump this gas for a distance of 100 miles, the thermal equivalent of the power consumed would be only about 1.5% of the therms in the gas transmitted, and this would be appreciably less than the resistance losses incurred in the electrical system.

It has sometimes been suggested that long distance gas transmission may offer some economic advantages if the gas can be manufactured at large and efficient works, favourably situated at sites where cheap seaborne coal is available. It is appreciated that such a problem is not capable of ready solution as many different factors are involved, but in view of the considerable increases in rail freight charges for coal within the last year, a general examination of the relationship between coal freight charges and gas transmission costs may be worth while.

An attempt to correlate this data has been presented in graphical form in Fig. 11 and it is based upon a London works receiving seaborne coal, in relation to other works with similar operating charges, fed with rail coal and situated anywhere within 60 miles radius of London. It is assumed that 90 therms of mixed coal gas and carburetted water gas at 500 B.Th.U. are obtained per ton of coal and the net coke for sale is 8 cwt.

RELATION BETWEEN COSTS OF BULK GAS TRANSMISSION & COAL FREIGHT CHARGES



THE GRAPH SHOWS ALTERNATIVE PUMPING & TRANSPORT CHARGES INVOLVED IN SUPPLYING ANY TOWN WITHIN 60 MILES RADIUS OF LONDON.

(1) BY SEABORNE TRANSPORT OF COAL TO A THAMESIDE LONDON WORKS & BULK TRANSMISSION OF GAS TO THE OUTLYING TOWN ----------

ADDITIONAL COST OF CONVEYING COKE TO THE OUTLYING TOWN IF REQUIRED ——·——·——·——

(2) BY DIRECT RAIL TRANSPORT OF COAL TO THE OUTLYING WORKS FOR LOCAL MANUFACTURE — SOUTH OF LONDON, NORTH OF LONDON

CALCULATED ON A BASIS OF GAS WITH A CALORIFIC VALUE OF 500 B.Th. U/CU FT. AND A YIELD OF 90 THERMS OF COAL GAS AND CARBURETTED WATER-GAS PER TON OF COAL

THE CHARGES COVER TRANSPORT OF COAL & GAS-PUMPING COSTS (INCLUDING OPERATING, MAINTENANCE & CAPITAL CHARGES ON PUMPS & MAINS)

Fig 11

The dotted curves indicate the total cost of pumping various quantities of gas from 0.25 to 10 mill. cu.ft. maximum day to any point within a radius of 60 miles from London and for each condition the most economic combination of main size and pumping pressure has been taken. It will be noted that the origin of these curves is taken at 0.9d./therm, which represents the seaborne freight charge on the coal. The shaded area represents

(*Concluded on p. 274.*)

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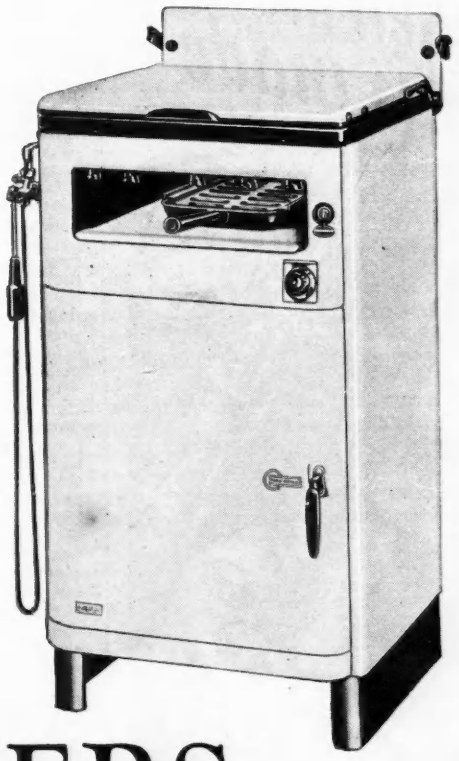

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(*Continued from p. 270*)

the range of costs for rail coal transport from the Yorkshire area to any point within the 60 mile radius, the upper and lower limits indicating whether the point concerned lies to the north or south of London. The curve shown at the base of the graph represents the cost of transporting the corresponding coke yield of 8 cwt./ton by rail from London to any point within the 60 mile radius and in affecting the overall comparison this should be added to the pumping charge, if coke is required at the particular town or works under review.

The general conclusions indicated by this graph are that the transmission of small quantities of less than 1 mill. cu.ft./day of gas is only justified for short distance of 5 to 15 miles, but that larger quantities ranging between 5 and 10 mill. cu.ft. per day may be justified for distance up to about 30 miles to the north of London and 60 miles to the south. This comparison assumes equal manufacturing costs at the various works under consideration, whereas in actual practice the lower production costs at large riverside works would add considerable weight in favour of transmitting gas for considerably longer distances.

Utilisation

From the comparison so far reviewed it is evident that the gas industry possesses many advantages as an efficient and economic means of converting and distributing the potential heat energy of coal. In the final stage, however, electricity can usually be converted into the required forms of energy very efficiently and the overall economics of the gas or electricity service can only be assessed after considering all three stages of manufacture, distribution and utilisation.

For power production, the conversion efficiency for electricity is from three to four times that for gas and for lighting the ratio is even greater. It is, therefore, not surprising to find the gas consumption for these two purposes to be very small and such supplies are usually only continued in those cases where abnormally high electricity tariffs are imposed.

In the case of applications for industrial heating, gas and electricity have to compete with solid and liquid fuels of considerably lower cost. The comparative efficiencies of these fuels varies considerably with the different applications and although electricity usually gives the highest efficiency, its greater cost invariably restricts its use to specific cases, where very high temperatures or special controls are required. The fact that gas can offer an attractive and economic service for many industrial heating purposes was illustrated by Mr. Garrud in his paper* to this Association earlier this year, from which it will be recalled that the demand for industrial gas in the Gas Light district of the North Thames Gas Board has more than doubled within the last 15 years and this surely is a proof of the practical advantage of gas in this field.

The most important load to the gas industry is that afforded by the domestic consumer, and in the London area this amounts to some 75% of the gas made. As indicated earlier, the largest single component of this load is the cooking demand, which serves as the real backbone of our industry. In making comparisons between gas and electricity for this purpose it is not practicable to assess the cooking appliances on a basis of pure efficiency, for it is known that the absolute efficiency of an oven varies with the type and amount of food being cooked. It is, therefore, more common to compare these appliances on the basis of heat input required to cook a specified and typical range of meals repeating as closely as possible average domestic practice.

Comparative Figures

Mr. Masterman† has shown that for cooking purposes, 20 units of electricity are required to perform the same work as one therm of gas and subsequent investigation has shown that this relationship holds for the overall range of domestic gas usage including space heating, due allowance being made for the relative load factors of the different types of appliances. Now the fundamental thermal equivalent between the alternative fuels is 29.3 electrical units to one therm of gas, so that for all-in domestic and cooking purposes, electricity possesses a theoretical utilisation advantage in the ratio of 1.5 to 1.

When this is considered in relation to the much greater manufacturing efficiency of gas relative to electricity, which is in the ratio of about 2½ to 1, the overall balance of nearly 2 to 1 comes out well in favour of gas for supplying this type of load.

The gas industry has considerable potentialities for future development, providing possibilities for improving technical efficiency and reducing capital expenditure on production plant. Its flexibility in producing gas from various fuels, as well as supplying smokeless solid fuel and basic chemical materials, may prove to be of great value to the nation in meeting possible changes in its economic structure.

We may feel justly proud that the spirit of private enterprise has brought our industry, after 130 years, to a position of such high standing and promise and that by combining the best of the old with the opportunities afforded by the new large scale organisations, the industry may go forward to even greater success and achievement in a spirit of enterprise and public service.

* An Industrial and Commercial Gas Sales Organisation—Mr. T. V. Garrud, paper presented to the London and Southern Junior Gas Association, Feb., 1949.

† The Future of Gas Appliance Design—Mr. C. A. Masterman, paper presented to the Institution of Gas Engineers, 1935-37.

TRADE NEWS

Bulletin No. 4 published by **Dowson & Mason Gas Plant Co., Ltd.,** Levenshulme, Manchester, 19, illustrates the range of 'Carbottom' furnaces for stress relieving, annealing, normalising, hardening, and other duties. This design is especially adaptable for objects or materials too large or difficult to handle in other types of furnaces, and is available in 10 different sizes. The bulletin contains eight photographs of the furnaces at work in a variety of industrial processes.

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Keith Blackman, Ltd., Mill Mead Road, London, N.17, have issued a new folder dealing with their latest 'Extravent' fan. Features of this fan are its light weight (7 lb. for a 6 in. unit, and 10 lb. for a 9 in.), low power consumption, and ease of mounting. It is made of aluminium construction throughout, combining lightness with strength, and is highly resistant to atmospheric corrosion. Silence in operation is another virtue which is claimed by the manufacturers in a leaflet which includes illustrations of the appliance in use in office, bathroom, and restaurant.